بنوك المعلومات الإلكترونية والبنية الأساسية للمعلوماتية

Electronic Data Banks and
The National Information Infrastructure

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ABSTRACT

In recent years, the subject of the National Information Infrastructure NII), described as a data superhighway, has been receiving greater attention in both scholarly and trade publications. The issue is expected to have significant implications for the use of electronic communication in education, business, industry and government. Interestingly, the origins of NII were in the sector of higher education. The National Information Infrastructure today represented by the universally accessible telephone system, broadcast and cable television, Electronic Data Banks (EDB), libraries, bookstores, remotely accessible databases, and the Internet. It is ultimately supplemented by broadband switched networks with digital connections to homes and public facilities, it is an electronic market for information, and an electronic townhall. Despite the significantly broader applications of the NII that have been legislated over the last few years, there is scarcity of research that has attempted to integratively review the key issues and principles that underlie the concept of the NII, the primary participating in its implementation, the current status of these issues and the future implications for education, business, industry and government. By providing an integrative perspective of the issues discussed above, such research is expected to support the studies in the field of electronic communication and information exchange via Electronic Data Banks EDB and introduces solutions for providing high bandwidth local access services to these banks. While the growth of the Internet has been impressive, the NII is a much more comprehensive, ambitious initiative that necessitates resolving significant issues and meeting critical objectives for Electronic Data Banks as will as other applications.

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I. INTRODUCTION

In a global economy that is increasingly information intensive, almost everyone agrees that an advanced information infrastructure is the key to economic growth and value creation. The economy of any country is increasingly dependent upon the capture, manipulation, transmission and consumption of information. The ongoing information revolution is expected to influence every facet of man's life, be it work or leisure. Companies in all industries are using information technology to re-engineer themselves and to become globally competitive. Businesses are gearing up to be a part of today's global information economy and tomorrow's world knowledge economy. Customers of tomorrow are expected to buy knowledge-based products with more intelligence built into them. Businesses are expected to build knowledge bases that will grow and evolve organically and help managers understand existing usage trends and plan new opportunities. The impact of the information revolution has been so significant that it has been suggested that some of the key Government economic indicators may not reflect the reality of the information-based economy. Various estimates suggest that between one-half and two-third of the workforce be employed directly or indirectly in the information sector of the economy. Telecommunications and information are vital to the public welfare and national security. Rapid technological advances being made in the telecommunications and information fields make it imperative that the countries maintain effective national and international policies and programs capable of taking advantage of continued advancements. Telecommunications and information policies and recommendations advancing the strategic interests and the international competitiveness of the United States are essential aspects of the Nation's involvement in international commerce. There is a critical need for competent and effective telecommunications and

information research and analysis and national and international policy development, advice, and advocacy by the executive branch of the Government. As one of the largest users of the Nation's telecommunications facilities and resources, the Government must manage internal communications operations in the most efficient and effective manner possible. Considering the vital role of the information and communication infrastructure, and realizing that the national telecommunications and information policy had not kept pace with the latest developments in telecommunications and computer technology, there was a need for accelerated deployment of a National Information Infrastructure (NII). The primary objective of this initiative was to facilitate development of a national policy that would encourage competition and rapid deployment of new technology. This was expected to provide a regulatory environment in which the private sector would feel encouraged to make the investments necessary to build the national information network that the country needs for competing successfully in the next century.

II. NATIONAL INFORMATION INFRASTRUCTURE

The National Information Infrastructure is expected to provide for "the integration of hardware, software, and skills that will make it easy and affordable to connect people with each other, with computers, and with a vast array of services and information resources". It is anticipated to be "a seamless web of communications networks, computers, databases, and consumer electronics that will put vast amounts of information at users' fingertips". This seamless web "of communications networks including computers, televisions, telephones and satellites" is expected to forever alter the way man "live, learn, work and communicate with each other both nationally and around the world". The building of the NII becomes a

commitment to meet the information needs in the Information Age. This infrastructure is expected to expand the level of interactivity, enhance communication, and allow easier access to various kinds of services. It is expected to accelerate the transformation of this society to the Information Age, and provide increased accessibility to a vast array of electronic information resources and services.

a) Overview of the NII Concept

The concept of the National Information Infrastructure is based upon the following fundamental principles: Encouraging private investment in the NII; Promoting and protecting competition; Providing open access to the NII by consumers and service providers; Preserving and advancing universal service to avoid creating a society of information "haves" and "have- not"; Ensuring flexibility so that the newly-adopted regulatory framework can keep pace with the rapid technological and market changes that pervade the telecommunications and information industries.

According to the National Information Infrastructure Agenda for Action, provides an overview of the goals and objectives of NII, the implementation of the NII is expected to:

- Promote private sector investment to increase and expand competition in communication and information markets, where that is needed for communication reform, legislation of the markets that have been dominated by monopolies, and revision of tax policies to provide incentive to the private sector for doing R&D on the NII;
- Extend the "universal service" concept to assure that information resources are easily available to all people at affordable prices,
- Promote technological innovation and new applications in both private and public sectors, and

continue to fund basic, risky and expensive projects;

- Promote seamless, interactive, user-driven operation of the NII to ensure interoperability and openness of the NII components with efficient, high-capacity, and standardable multi media services;
- Ensure information security and privacy of the information systems, networks and media of communications for all individuals and organizations, and to ensure network reliability and reduce its vulnerability;
- Improve management of the radio frequency spectrum to ensure that spectrum scarcity does not impede the development of the NII ;
- Protect intellectual property rights, and balance that with the public interest in promoting the dissemination of information, and to apply these rights to all forms of information in the electronic environment, and to reexamine and strengthen the copyright laws domestically and internationally;
- Coordinate with other levels of Government and with other nations on the regulatory policy, and on export control policies to remove restrictions and eliminate barriers; and
- Provide access to Government information and improve Government procurement of information.

The NII seeks to enhance national competitiveness and improve quality of life of the general populace. The development of NII is promised to be one of the most important contributions to the nation's economic and social challenges. Regardless of diverse professions, needs and desires, expectedly, be able to access enormous benefits in terms of Government services, commerce, business, health care, and education. Some expected possibilities of NII include advances in medical treatment and research, creation of jobs, increase in economic growth and productivity, reduced heath care costs,

and quick verification of critical information.

Increased availability and accessibility of services and products provided through the NII is expected to dramatically affect the way in which individuals conduct their everyday affairs. The public will use directly or through intermediaries, the depository libraries, other public libraries, and private sector information services. Direct users will have access to a government Core accessible on the Internet without charge. Intermediate access may include electronic mail, bulletin boards, FAX, and off-line media such as floppy disks, CD ROM, and printed works.

As the transportation infrastructure becomes more complex, one can benefit from the application of the NII to such operations as toll collection, motor vehicle registration, and traffic routing. As the NII becomes more interconnected, citizens and organizations are expected to engage in multimedia communications, as well as sell goods and services electronically, share data resources.

b)Scope of the NII

The NII includes the following four specifications:

- The NII must be an integral part of the Global Information Infrastructure (GIl). In the globalization of markets, resources, and economics, global accessibility and use of information is very critical.
- The NII l must be ubiquitous and affordable enabling all individuals to be both consumers and producers of information in all forms. The NII must be capable of adapting to changing social and market needs.
- The NII must be driven by its users - both information consumers and producers . It must offer the users convenient access and the initiative to learn and use Nil. Further, usability must be provided for any disabled persons.
- The private sector must have primary responsibility for the

design, deployment, and operation of the NII. However, all the levels of Government will have the roles to play in ensuring the effective development and deployment of the NII.

For operationalizing these specifications, the fundamental principles are specified in five key areas:

- Universal Access and Services
- Privacy and Security
- Intellectual Property
- Education for Lifelong Learning, and
- Electronic Commerce.
- Universal Access and Services Principles:

By the end of this century, the goal is to have the deployment of the NII access and services capabilities to all community-based institutions serving public, such as schools and libraries

Privacy and Security Principles: There is a set of general and specific principles that address the issues of privacy, integrity, and quality of the personal information on the NII. These principles can be categorized into four major classes: General Principles, Principles for Users of Personal Information, Principles for Information Providers, and Intellectual Property Principles.

III. KEY ISSUES O THE NII

Development of the NII has been evolving since postal services and semaphore were established. The need for a formal NII initiative was spurred by an increasing pace and scope of changes due to the convergence of various digital technologies. The private industry will be primarily responsible for creating and managing the networks, the information tools and applications, and most of the information traversing the NII. Yet,

a) Key Issues Identified

Within this perspective, some key issue areas are identified, that need to be addressed for the implementation of the NII. These areas have been categorized into:

- People Issues, concerned with the users of the NII;
- Information Issues, concerned with the commodity of the NII;
- Software, hardware, and network Issues, concerned with the media of the NII; and
- Finance Issues, those concerned with financing the NII.

The specific issues under each of these categories are listed below.

b) People issues

Providing equitable access to the NII

- User acceptance of NII applications,
- Privacy safeguards for individuals and organizations,
- User training,
- Organizational learning,
- Private sector acceptance of Government-developed applications technology.

c) Information issues

- Intellectual property rights,
- Information security, including confidentiality,
- integrity, and authenticity,
- Information access, storage, and retrieval,
- Information and data standards,
- Information conversion from "old" storage to NII media.

d) Software, hardware, and network issues

- User friendly hardware and software that maintain accuracy and reliability of the systems
- Interoperability standards that preserve the system security, accuracy, and reliability
- Scalability from small pilot projects to widespread use.

e)Finance issues

- Cost and pricing of the applications and uses, who will pay, and how that can be economically efficient and socially beneficial
- Public funding, how it will be used for development and deployment of the applications.

IV. STAKEHOLDERS OF THE NII

The stakeholders of the NII include all parties involved in the various aspects of its implementation.. While the Government is primary playing its rule-making role, its various agencies are instrumental in shaping the policies that are amenable to the success of the initiative. Yet, without the private sector, NII would not be possible. The various companies involved in the creation, publication, transmission, storage, organization, dissemination, recycling or processing of information, or in providing the facilitating hardware or software, would be primarily instrumental in constructing the NII. Most of these companies would do so to satisfy their own strategic or competitive objectives, in most cases related to sustaining existing customers and securing new markets. In other words, all companies involved in one way or another in providing information products or services would need customers who have the willingness and capability to buy those. Hence, to ensure the long-term viability of the NII, customers should be sufficiently motivated to buy the information products and services available on the NII. The information services and products will be accessible at negligible cost to the taxpayers. Various kinds of consumer groups would be involved in ensuring that the interests of the customers using the NII are adequately safeguarded. Due to the key role of information in education and learning, educational institutions, academia and libraries would be involved in the creation as well as usage and dissemination of various kinds of information. The NII has received wide coverage by the mass media as a broad-based multimedia national resource accessible to all people.

The various stakeholders can be divided into four broad categories:

- Those who will own the information network, primarily the private sector firms;

- Those who will create user-end information processing devices such as TVs, telephones, computers, and their composites, etc.;
- Information providers such as local broadcasters, digital libraries, information service providers, and individuals who want to sell or share information; and most importantly,
- Information customers, who would demand quality products at affordable prices. The users and providers of information would have different, though overlapping, needs for the NII services. The information users would have the following types of needs: Searching, discovering, updating, transforming, and retrieving useful information; building and maintaining electronic repositories of information; creating and distributing information electronically; executing and recording commercial, legal, financial, and other business transactions; and, supporting collaborative work efforts among collocated or remote individuals.

V. IDENTIFYING REQUIREMENTS FOR NII

The information infrastructure Standards Panel (lISP) was created by ANSI and tasked with identifying requirements for standards that will be needed to develop the National Information Infrastructure NII). This document provides a conceptual framework to guide this process of identification. It is intended to serve as a mechanism for standards developers, Standards Development Organizations (SDOs), and others to identify areas where standards will be required. Where requirements for standards have been identified, the framework can be used to pinpoint existing and emerging standards that are candidates for satisfying those requirements. Identified requirements that cannot be matched to the existing

standards represent "gaps" that may need to be filled. It is expected that in the coming years, SDOs will fill "gaps" by creating new standards, evolving existing standards, or introducing mechanisms to take the place of standards. These standards will be needed to ensure that the creation and provision of new technologies and services by commercial vendors can be easily integrated with existing technology. The results of the standards identification work will be recorded in a Standards Development and Tracking System maintained by the lISP.

In recent years, a number of architectures for the NII have been proposed including [1], [2], [3], and [4]. This framework is not intended as an NII architecture, nor does it subscribe to any proposed architecture. Such an NII architecture can only emerge as a result of long-term technology, economic, and social drivers. Instead, the framework is intended as a guide to facilitate the identification and development of standards that will be needed to realize the Nil. The framework is designed to reflect the perspective of following three groups:

- users and NII applications,
- technology vendors and NII services, and
- standards developers and interfaces--with the ultimate goal being the identification of requirements for standards for the NII to support the development of flexible and evolvable technology that will be usable in a wide variety of applications.

a) Framework Components: Applications, Services, and Interfaces: The identification of standards requirements is based on consideration of three fundamental factors: NII services, application areas, and interfaces:

Application Areas**:** represent commonly understood spheres of activity in which human users will use the NII. Examples of such application areas include manufacturing, education, healthcare, and entertainment. Within application areas, technology vendors and users create application systems, consisting of both hardware and software.

***Services*:** represent well-defined capabilities provided through the NII that can support activities within different application areas. Technology vendors as hardware and software systems that can be integrated into many different application systems implement services. Examples of such services include collaboration (the ability for multiple users to work together on various tasks), electronic publishing, and commercial transactions. Services may also include multimedia support services, security services, and data interchange services.

***Interfaces*:** exist between the hardware and software systems that make up NII applications and/or services and the various external systems with which these applications and services must interact. The concept of interfaces provides a means for organizing the discussion of interoperability between systems; NII applications and services will interoperate across specific interfaces. Examples of such interfaces include interfaces between different application Systems (and component services), interfaces between application systems and information systems (databases), and between application systems (and services) and the underlying communications network.

Using the framework, requirements for standards are identified by:

(1) Considering the use of services in different application areas, and

(2) Considering needs for interoperability at critical interfaces.

Figure (1) illustrates the basic idea, showing a potential area of standardization at one point of intersection of the three axes.

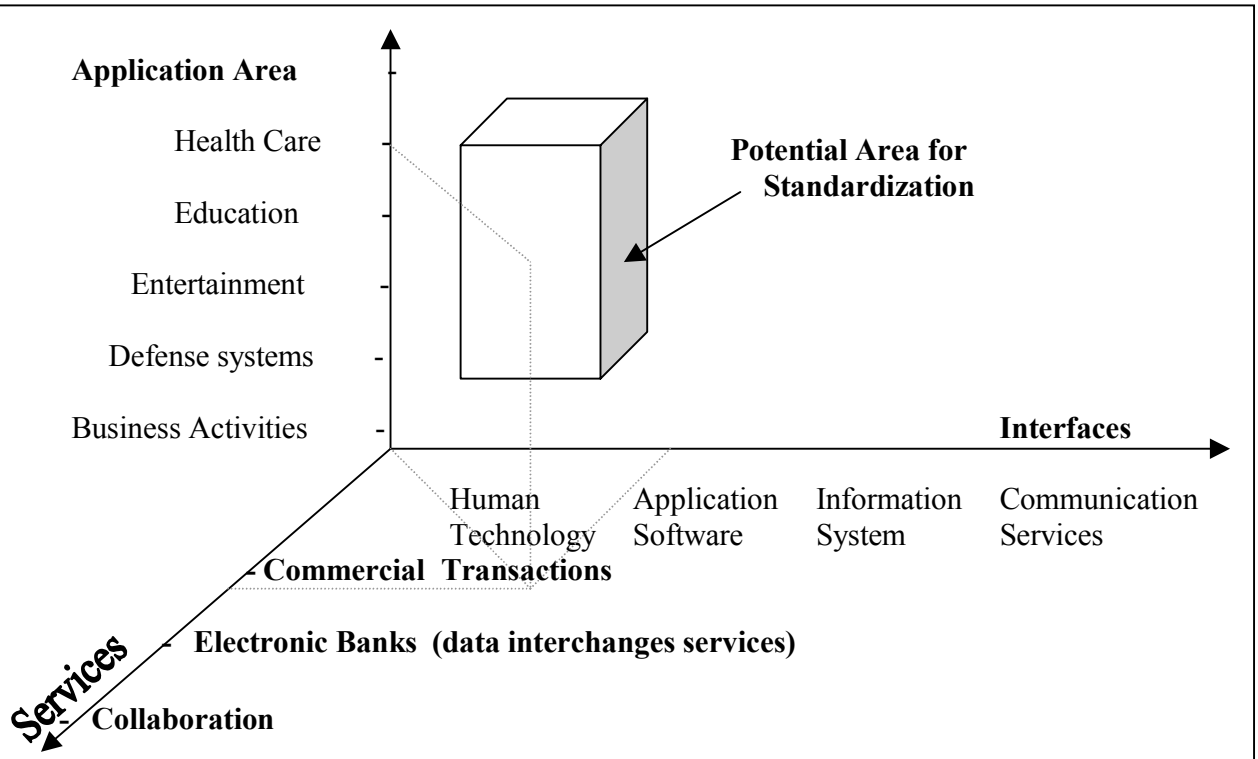


Figure (1)

Each point of intersection of the three axes represents a mapping of a particular enabling service to a particular application area and the requirement for achieving interoperability at a particular interface. For instance, it is necessary to consider what information systems interface standards might be appropriate for collaboration (cooperative activity) services in support of manufacturing applications. Each point in the model can thus be associated with a potential area for standardization. The elements listed along each axis are subjective.

b) ***Using the Framework to Identify Standardization Needs for the NII:*** The identification of requirements for standards within potential areas for standardization can be facilitated by considering attributes that particular services may have at specific interfaces. Attributes are aspects of the use of particular services for applications that need to be defined to allow services to

interoperate at particular interfaces. They point directly to needs for standards. Examples of attributes include the data format transmitted and the protocol required for systems associated with a specific interface to establish, maintain, and terminate communications. For two application systems to interoperate, they must have compatible attribute values (For example, two applications must have a common format for exchanging information).

*c) **Suggested Attributes for Identifying Standards Needs:*** The attributes described below can be considered for each potential area for standardization--to determine what kind of standards may need to be developed to provide a particular service to a particular application area. No standard set of attributes can be defined that would be universally applicable. It will be largely up to SDOs to define attributes that meet their needs. Different attributes are likely to be required for using different services in different application areas. A starter set of attributes to consider include:

*** Protocol**

This attribute addresses issues of basic communications, including the need for a set of conventions to establish, conduct, and terminate communications between two parties across an interface that may be either multipoint or peer-to-peer. Examples of protocol standards are Transmission Control Protocol (TCP) [5], Remote Data Access (RDA) [6], and the Z3 9.50 standard for retrieval of text information [7].

*** Format**

This attribute is concerned with specifying the structure for encoding information to allow its exchange between two parties (usually application systems). Examples of particular encodings include PDES/STEP [8], Electronic Data Interchange (EDI) [9], Hypertext Transfer Protocol (HTTP) [10], and SQL [11]. Other encodings for image, video, and speech are also critical to consider.

*** Content**

The specification of the type of information needed to support a service at an interface.

*** Distributed Control**

This attribute addresses requirements for functions associated with access, replication, migration, concurrency, and synchronization that are needed to support a particular service.

*** Security**

The process of controlling access to and/or maintaining the integrity of a service or the data used by the service. An example of a security standard is RSA.

In addition to suggesting new attributes, users of the framework may specialize existing attributes into more precise forms that are useful in their areas of endeavor.

VI. THE ROLE OF ELECTRONIC DATA BANKS IN THE NII

The ability of digital data banks to store and share knowledge, history, and culture will be central to the success of the NII. The Electronic Data Banks used here as an aggregate, implying electronic access to many sources of digital information such as corporate, government, and research entities. Increasingly materials are being acquired in electronic form; Information and knowledge are beginning converted to machine-readable formats for both preservation and spatial reasons.

As today, the role of EDB in the future will be to advocate and help provide information equity for the public. It will continue to coordinate and facilitate preservation of the records and expressions of the nation's intellectual and cultural life both in traditional and digital formats. Electronic Data Banks will be sources of free or inexpensive digital information; provide access to an improved flow of electronic government information and world-wide digitized resources; request and be sent copies of remotely stored documents and other publications as allowed by copyright licensing and other agreements; make digitized reproductions of rare and unique material that is in the public domain or for which permission of the copyright owner is available as allowed under the copyright law; and provide long-term

access to the records and expressions of culture and scholarship.

The evolving information infrastructure is already dramatically changing traditional operations within and relationships among EDB and their providers and users. It is also offering new challenges. New forms of unpublished, and often unauthenticated, digitized materials are emerging as millions of people are linked by worldwide networks. The volume of new digital material, if it were on papre, would eventually dwarf the existing physical collections. The situation is additionally complex because digitized information can be easily updated, manipulated, and combined with other materials, and displayed in multiple ways. Digital data thus creates enormous new amounts of knowledge that maybe accessed and manipulated by computers, existing temporarily and never stored anywhere permanently. Institutions may provide access to these materials without ever physically controlling them, and readers at multiple sites have access to the same material at the same time.

While the Electronic Data Banks within the context of the NII is a national initiative, there are significant international implications both for the sharing of information across national borders and for the shift in the organization of intellectual creativity. Questions of international cooperation and economic competition will arise. Because the infrastructure permits international access to digital information in a way that is impossible in the traditional model, new international relationships and models can and will emerge.

Without taking into account from the outset rules for effective protection of intellectual property, the development of an international system, the Global Infrastructure (GII), will be severely hindered. In a global system a user in one country will be able to manipulate information resources in another country in ways that may violate that country's copyright laws. Copyright laws are territorial; international copyright conventions and other multilateral

agreements allow for significant differences in national laws. Work must begin on international harmonization of copyright laws to accommodate digital worlds.

***The Application*:** Digital Data Banks in the NII will contain vast amounts of digitized data: text, pictures, audio, and video. The data will be located at any single site, but rather will consist of digitized material and processing methods from many sources. The development of digital collections in EDB will depend on the following components:

- Interconnected and Interoperable Networks. Electronic Data Banks are premised on the existence of a network of networks, interconnected and interoperable.
- Databases. Digital Data Banks will contain data that only exists digitally and digitized data that has been converted from another medium such as print, sound, or audio. Developing techniques to consistently collect, store, and archive digital material using automated methods is an important first task for the digital Data Banks community. The conversion of existing material to digital form also is important. This converted material will form the nucleus of the digital database and provide a bridge to traditional collections.
- Navigation and retrieval tools capable of identifying, accessing, and retrieving the digital resources must be developed. When practical, major navigation and retrieval tools will be based on standards that ensure the ability to communicate in order to share both data and processing.
- Document Delivery. The ability to deliver physical copies in print or in any of several fixed digital formats must be supported. While a technical component of the applications, involves significant copyright issues that must be resolved. Downloading substantial amounts of copyrighted material will require license agreements with related questions of who will pay and how will they be administrated Guidelines must be

developed as to what are insubstantial amounts of downloaded materials, subject to fair use exemptions.

- Presentation standards and techniques to assure reliable and effective representation of intellectual content must be created.
- Mass Storage. The ability to store increasing amounts of data at steadily decreasing costs is a technological trend that is vital to the massive amounts of data DDB will need to store and support.
- Human Resources. The most critical success factor for the success of digital Data Banks will be the human resources component. This components assumes the education of a new generation of administrators as knowledge navigators; training and training of the public in the new technology and the use of electronic information resources.

The benefits of linked Electronic Data Banks include continued and expanded access to current information and access to vast amounts of digitized data in unparalleled detail. Technical barriers to information sharing will largely disappear. Data Banks must continue to play their vital role of information safety net for the public by providing access to and promoting literacy of digital materials.

a) Electronic Data Banks and the NII Goals:

Long-Term Goals: The Long-term goal of the NII is a world of ubiquitous information. The realization of this vision for Electronic Data Banks depends on the reliability and universal accessibility of the information infrastructure. Society must not only have the ability to support projects to gather and control electronic information but must also underwrite funding to assure basic access. The realization of this vision is dependent on technological advances and policy that Will allow all of the interested entities to work together within a single network and policy framework, whether corporate, government, research, or entertainment.

Achieving this long-term goal requires that commercial providers of

information, and user communities discuss, explore, and develop a new paradigm for their roles in the evolving electronic community. Copyright, funding, standards, and privacy and security issues must be addressed in both the short and long runs.

b) Short-Term Goals

**** Copyright***

It is obvious that we are at the beginning of an enormous revolution in communications. The copyright law is at the center of this revolution and will determine the course it takes. The bulk of electronic material will be copyrighted, as is the bulk of published material today. The issue of the protection of copyrighted material must be addressed (effective and administratively feasible licensing system will be the key). For now, there is a standoff. Copyright owners (publishers, information providers, authors) and others with interests in this area must come together to model agreements covering on-premise online access, transmission to the public, downloading and reprinting, and feasible payment mechanisms.

**** Funding***

Electronic Data Banks are to participate in the NII so, funding is required to support all aspects of their electronic evolution. Funding to continue current operations is basic. Funding to provide broader access and to strengthen the technical positions of public, depository, and academic libraries offers the possibility of providing equitable access for all.

**** Equity of Access and Education***

The specter of information in midst of the wealth of NII information must be averted. Access and education are two keyways to increase the probability that the number of the information will be reduced. What should the government's role in reducing the potential for information be and how can it achieve the vision of universal access? How should the government fund programs for public gateways and for the education of librarians in the new technology?

What institutions will act as gateways for those not having access or technical knowledge sufficient to make use of the NII? Isn't this the emerging role of EDB? What role will the government play in funding the education of the NII knowledge organizer-navigator? Isn't this the emerging role of EDB in the NII? Who will be trained to be the knowledge organizer and navigator of the NII databases?

Providing access and strengthening the technical position of Electronic Data Bank offers a strong possibility for providing equitable access. One means of doing this is to extend and re focus the Bank Services and Construction Act to explicitly encourage Data Banks particularly public and depository, to become public gateways to the National Information Infrastructure.

**** Digital Conversion***

Much of the concern of the National Information Infrastructure has been with connectivity and access. While discussions of digital initiatives are generally broad, the issues surrounding the digitization of these holdings are frequently avoided. Who is going to do the digitizing? Should this be undertaken by a single institution or by multiple institutions? What institutions(s) have the holdings and the expertise to initiate significant pilot projects in this area? What comprises a significant set of material worthy of the funding of such major projects? How should the government fund these initiatives? It is clear that market forces are unlikely to produce the resources required to initiate this effort on a meaningful scale. However, are there private entities that could help supplement federally initiated digitization projects?.

**** Investment in research and development***

Which areas to be considered for research have the potential to contribute the most rapid development and orderly growth of Electronic Data Banks as part of the NII? What searching aids could be designed for the short term, For the long term? What basic architectural component of the Data Banks is in place? Which are missing? What issues must be resolved

before the public will be willing to depend on the network in the same ways it trusts traditional libraries and the voice network? What are the models for preservation in the NII, both for material that only exists in digital form and material that exists in other forms that are endangered? Who will provide a testbed for digital repositories? What should be included in this testbed?.

* ***Coordination and Review of Standards***

Better coordination of standards-setting groups should be initiated so that standards on Internet working, interoperability, and security are created and adopted in a more timely way. In a dynamic and quickly changing environment such as the Internet and the future NII, standards groups must consider streamlining the process for setting standards and creating a process to adopt that standards when they are useful. How can the government most effectively participate in the setting of appropriate standards for Electronic Data Banks?

Any national efforts to review standards-setting groups and methods should be undertaken with a clear sense that the network is already an international entity and that its international components is likely to grow as quickly (or quicker) than the national entity.

VII. PROVIDING HIGH BANDWIDTH TO ELECTRONIC DATA BANKS

The full varieties of solutions for providing high bandwidth local access services have yet to be adequately explored. What other interesting approaches have yet to be considered?

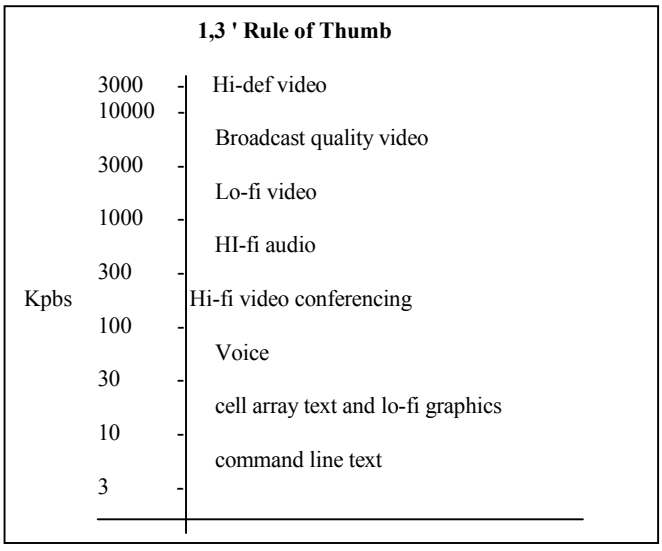
- CableCo/Cable Modems- Cable has been the long standing bandwidth leader. For at least 10 years, even before hybrid-fiber-coax technology (HFC), there has been talk about the coax cable plant as a vehicle for delivering high bandwidth into the home. The core technology was used in military communications more than 2 decades ago.

- Telco/ADSL-ADSL on the existing twisted-pair copper-wire telco plant, though originally oriented toward video on demand (VOD), is being positioned as Telcos' answer to the cable modem. ADSL is an important first step for the telephone companies.
- Fiber to the Home (FTTH) - FTTH has always been a future promise. FTTH is characterized as "not cost effective now, but will be in the near future".
- Microcellular VHF-As a wildcard scenario, what if we were to retire 20 channels of television spectrum ,prime spectrum that goes through walls and buildings, and reallocate it for interactive data communications. What could we achieve? Easy mobility and access across geographic locations in the same spectrum space, etc. However, the technology to deploy microcellular is not quite here. If you're looking for a place to invest in technology, this particular form of microcellular could be high leverage.

The following tables summarize our analysis. Look at criteria across the selected scenarios to see what the important differentiates are.

	Cable Modem	**ADSL**	**FTTH**	**Microcellular**
Critical Bandwidth "1.3 Rule"	10 Mbs down/ 10 Mbs up or 30Mbs down/ 3 Mbs up (shared access, ~200)	ADSL : up to 8.192 Mbs down /640 Kbs up Distance/line Sensitive (dedicated line)	51 or 155 Mbs (fractional) dedicated line)	10s Mbs (Shared Access)
Bandwidth Symmetry Asymmetry	Choice of symmetric & Range of asymmetric	Inherently asymmetric	Symmetric	Potentially Symmetric
Privacy, Security, and Network Management	Shared link in neighborhood Hard to isolate Catastrophic failures	Dedicated link more private and secure Slight regulatory Advantage		Shard link
Mobility	Speculative			Only cellular offers inherent mobility
Product Technology	Three chip solution $40-100 Twice the cost	Single chip solution $ 20-50 Twice the modems	$30-50 loop fiber xmtr/rcvr	Undefined technology Expected costs Comparable to cable modem
Deployment Realities	HFC promises q single plant for TV, telephony, and date Sharing limited	Initial deployment : upgrade DLCs, run new fiber where necessary (long term : FTTH Crosstalk limited)	Extensive initial build Buried cable? Cost limited	Initial cell sites Incremental cell subdivision Spectrum limited

Technical Analysis: Look in detail at the first two criteria, critical bandwidth steps and bandwidth symmetry /asymmetry. An important aspect of bandwidth that we've recognized in our work for at least 15 years is that bandwidth effectively comes in steps where each step enables a new class of applications. We refer to this as the `1,3 Rule', because the steps roughly follow an exponential progression of 1, 3, 10, 30, 100, 300. The following chart shows the primary applications associated with each step. Of course, there is some overlap from step to step, and these are not hard and fast boundaries, but rules of thumb. The chart continues beyond 30 Mb/s too even more involving applications.



There is an important interplay between critical bandwidth steps and the second criteria bandwidth symmetry/asymmetry. ADSL and some canle modem approaches are inherently asymmetric. Though the down streams channel is fairly high bandwidth, the upstream channel is relatively low bandwidth. Thus, inherently symmetric applications are precluded, such as high quality video conferencing that grandma would be comfortable using to view the grandkids.

The critical-bandwidth-steps concept has important implications to services that spread across a range of steps. ADSL performance is limited by cross talk in the wire bundles and varies widely depending on distance from the central office and line conditions. Cable modem performance is limited. This is more than a "your mileage may vary" issue. Certain applications may work for your neighbor, but not for you or you may find you can look at video clips at 2am, but not at 7pm.

Indeed, sooner or later local access systems will commonly support video conferencing and the ability to originate graphically rich multimedia content directly from home servers. We estimate this crossover point to be a 3Mbps symmetric service. This is the point at which a user can both originate and receive at least one of any given data type that is in common use today. Above 3Mbps becomes a matter of how many simultaneous data types can be serviced.

Some criteria are not substantial differentiators between approaches. For example, in comparing product technology, it is encouraging that whereas a few years ago no practical solutions technologies seem to be a breakway universal solution. ADSL modems could cost half as much as cable modems, but you need to deploy twice as many. Microcellular modems can be expected to follow the same cost curve as cable modems. Any of these technologies can be deployed as appropriate to the situation. The prospect the multiple solutions will likely move forward, raises important interoperability and portability issue.

***Business Analysis*:** Consider capitol investment and deployment realities scenarios, and recognize the very different business models under which these industries operate.

Cable is generally debt financed, so in order to invest in upgrades the company needs to issue debt. Bankers look to justify new dept largely on the sales and maintenance of conventional cable television services. On this basis, cable companies can usually justify building fiber out to 2000 home nodes where at 10% penetration a user effectively shares an Ethernet with 200 other potential users. The next step, 500 home nodes, can be achieved by upgrading node lasers and electronics to get 40% penetration with the same level of sharing. To improve quality of service, the level of the sharing must be reduced, which can be done by reducing penetration, perhaps by charging more for the service, by further subdividing the plant, and/or by adding channels.

Telephone companies, on the other hand, are largely self-financed, putting large amounts of upgrade cost into the rate base. Since ADSL adapts to line conditions, it claims potential continuous deployment up to an estimated 60% penetration. Revenue at these higher penetration levels likely justifies building out fiber closer to the home.

***Speculative Scenario-Microcellular VHF*:** We can also look for new scenarios that exhibit more of the beneficial characteristics we are looking for. In the microcellular scenario, we speculate using retired television spectrum to deploy a new data service. Upcoming digital television transmission, because it is more spectrum efficient, promises to greatly enhance the services that broadcasters can offer at the same time release a substantial portion of spectrum for new uses.

This approach could remove the partition between mobile, portable, and stationary systems. Many of the necessary component technologies exist to build a microcellular system: wireless LANS, packet radio networks, and digital broadcast system. Such a system could be symmetric capable and easily offer shared access to 10s of megabits per second within each cell. Microcellular product technology would follow similar cost curves to cable and ADLS modems. Cells size would be scalable to permit incremental service deployment and upgrade to optimize frequency reuse-initially a small number of cells, and subsequent cell subdivision to meet increased demand.

The reason for pursuing television spectrum is that it has a number of good transmission qualities, e.g., it penetrates walls. Spectrum, currently considered for data services, is poor quality; it is non penetrating and typically requires line of site transmission, which mulltlifies many of the sought after benefits or wireless.

Satellite Broad Band Systems: Given the anticipated benefits, it is certainly worth allocating high spectrum to promote a National information infrastructure.

If a network as bandwidth and access-limited as the Internet can have

such an impact, the possibilities of a satellite or Global Stratospheric Telecommunication Server "GSTS", network are staggering. The inevitable multitudes of new applications that will become possible will eventually make seemingly exotic applications, like telemedicine or distance learning, seem pedestrian. Whether the satellite companies can deliver on this promise remains to be seen.

Along with every other radio communications device, satellites a dedicated piece of the spectrum. Currently, the International Telecommunications Union-ITU, has allocated 2.5 0Hz of spectrum for Fixed Satellite Services in the 28 0Hz ka band. Requests for single applicants range from 750 MHz to the full, 2.5 0Hz with most applicants requesting 1 0Hz of spectrum. It remains to be seen which of the fourteen companies will receive spectrum and how much each of them will receive.

Another spectrum issue is that of blocking. The reason the ka band has not been used in the past is because such high frequency transmissions are easily blocked. Buildings, trees and other solid objects can cause a loss of signal. This makes these frequencies unsuitable for use by ground based systems because they would require a large number of transmitters to be able to avoid all obstacles. Satellites avoid many of the problems associated with blocking because their signals come form directly overhead. Buildings and trees do not present an impediment to signals coming from overhead satellites.

There are two basic types of satellite systems being proposed, Geosynchronous Earth Orbit (GEO) satellites and Low Earth Orbit (LEO) satellites. GEOs orbit in the Clarke belt, approximately 35.000 km (22.000 miles) above the equator. The orbit at this altitude over the equator is the only one in which a satellite can stay over the same area of the earth for an indefinite period of time. Each GEO servers one geographic area, and can theoretically cover about 41% of the earth's surface. Companies proposing GEO systems are planning on using between three and

fifteen satellites to deliver worldwide service.

LEOs orbit 20 times closer to the earth, between 700 km (450 miles) and 1350 (700 miles) km above the earth's surface. Each LEO is moving constantly, covering a particular area for only a few seconds. Because of this, a network of much satellite is required to cover the entire world. There are currently two companies proposing LEO service: Teledesic, backed by Craig McCaw and Bill Gates, and M-Star backed by Motorola plans to offer high-bandwidth intercontinental links between network providers, rather than end users.

Global Stratospheric Telecommunications Service: Another futuristic idea that could deliver on the promises made by the satellite industry is the OSTS, proposed by Sky Station. A OSTS is a floating communications platform suspended 20 miles above the earth by helium balloons. This is higher than any conventional aircraft, but lower that any satellite. Sky Station proposes to launch 250 OSTS platforms, covering every major city and 80% of the earths' population. According to Sky Station, stratospheric platforms are far cheaper than satellites because they have very low launch costs and are not as technically complicated.

Besides being far less technically ambitious than a LEO constellation, a GSTS system would have several other advantages. One advantage is spectrum reuse. Because they are 20 times closer to the earth than LEOs and 400 times closer than GEOs, GSTSs can use spectrum many times more efficiently. Because of this spectrum efficiency and lower cost per platform. Sky Station estimates its consumer costs will be around 10 cents per minute for a 64 kbps channel. Spectrum efficiency would also give a GSTS enough bandwidth to serve large cities. The latency problem would also not be an issue with a GSTS only 20 miles above the earth.

In order to begin operation, GSTS systems must satisfy regulators and prove their technology. The first question is one of safety. 37 ton OSTS systems do not burn up before falling to earth, and because

they are hovering over large cities, a fallen platform could cause a great deal of damage. However, because of backup safety devices, the FAA has given sky Station preliminary approval for OSTS systems. Another difficult arises form spectrum scarcity, because the more desirable lower frequencies than satellites, in the 47 GHz range. At such high frequencies, tree leaves, windows, and even very heavy rainstorms can block the GSTS's signal.

In the future, GSTS systems may become the provider of broadband service for everyone. Its supporters claim that it will have enough bandwidth and low enough costs that is could be deployed in both urban and rural areas, and both rich and poor countries. However, like satellites, GSTS systems have many issues that have yet to be addresed.

***Possible Scenarios*:** It is clear that both satellites and GSTS systems have uncertainties surrounding them. A goal as ambitious as providing worldwide broadband communications necessarily will be difficult to achieve. For satellites, many issues remain about deployment dates, cost and technological feasibility. It remains to be seen how many of the fourteen applicants for spectrum in the ka band will actually be deployed. Below are some possible scenarios.

Both GEO and LEO satellites prove to be feasible, but at a higher cost than terrestrial technologies. This seems to be the most likely scenario, with cheaper terrestrial technologies being implemented in cities and populated areas and satellite systems serving rural areas and developing countries. Global GEO systems will probably be launched first.

GSTS systems become available at their estimated costs, at the estimated time, and with the expected bandwidth capability. GSTS systems could become the broadband access method of choice for urban or rural areas, developed or developing countries if they can be deployed as cheaply as their proponent's claim.

VIII. CONCLUSION

Although, the NII has been often described as a data superhighway, the caveats in this analogy need to be noted for the sake of avoiding misinterpretation. For example, the NII will not be built. It will evolve through the practical merging of the computer, communications, software, and information industries. While the highway system was largely developed with Government funds, the NII will be created through the traditional forces of the free market system and industrial competitiveness. This approach requires that the government be a partner, working with industry to transform the vision for an NII into reality.

Most of tomorrow's information services will evolve from the variety of new digital entertainment technologies. The new entertainment technologies would influence the shape of the emerging digital markets. Considering the significant role of technology in entertainment industry, the contends that the term NII disregards the significance of this industry. In his opinion, "national digital environment" is a better descriptor of "the sum total digital networks, devices, data stores, etc." The ongoing transition of computers from "manipulating numbers and text" to "manipulating images and sound" portends a radical change in the nature of computing. This perspective called "entertainment, than information" suggests the leading role of entertainment technologies in driving the progress of future information services. The significance of the "towns, communities and applications we connect to" over the highway - essentially suggesting that the more relevant question is "where you connect" rather than "how you connect."

The NII would be participative in nature where "every client is a server." It treats its users not as consumers of a product or service, but as contributors, as colleagues. One interpretation of the NII as a "convergence of technologies and of cultures" depicts it as an "electronic market" and an "electronic townhall". The National Information Infrastructure NII, today represented by the universally accessible telephone system, broadcast

and cable television, libraries, bookstores, remotely accessible databases, and the Internet, and ultimately supplemented by broadband switched networks with digital connections to homes and public facilities -- can be an electronic market for information, and an electronic townhall.

Another interpretation of the NII considers it to be a convergence of different cultures representing different segments of users such as broadcasters, telephone companies, and Internet users . Three desirable attributes of a practical (rather than ideal) information infrastructure are that it 1) be capable of evolution, 2) build upon current and existing capabilities in a cost-effective manner, and 3) support the ability of the user to gain access rights to critical information through online interactive methods. Flexible and effective evolution of the infrastructure must occur in order to support the increasing size of its user community and to dynamically add functionality as user needs grow. By building on the extant collection of systems and databases, the information infrastructure will maximize the likelihood that active users in the field will be comfortable using the resulting system.

The bottomline of the whole argument of the NII initiative can be summed as: "The greatest challenge to the implementation of the NII is the need to balance the incentives necessary for private investment against the need to meet urgent societal needs. This trade-off is likely to be complicated by the need for simultaneous competition and cooperation among the many firms that will invest in the NII ."

This issue has announced the Electronic Data Banks as central to the success of the NII . EDB have already begun to explore the challenges presented by electronic materials and navigation tools. Enhanced skills, roles, and alliances in the electronic environment must be explored and developed before the vision of NII digital banks becomes a reality. Electronic Data Banks are anxious to assume their place in this electronic world, but basic issues must be addressed. These issues include copyright licensing

schemes, collective rights administration and guidelines for fair use in an electronic environment, the availability of sufficient resources to ensure reliable connectivity and staff knowledge in network use, and database of sufficient quality and quantity to be useful to those in need of reliable information.

The full variety of solutions for providing high bandwidth local access services to Electronic Data banks have yet to be adequately explored. The brief analysis suggests a few interesting observations. For example, the microcellular approach stands out in that it addersses many of the criteria other approaches do not. Thus, it is a worthy candidate for investment and national attention. Also, both GEO and LEO satellites prove to be feasible, but at a higher cost than terrestrial technologies. This seems to be the most likely scenario, with cheaper terrestrial technologies being implemented in cities and populated areas and satellite systems serving rural areas and developing countries. OSTS systems become available at their estimated costs, at the estimated time, and with the expected bandwidth capability. GSTS systems could become the broadband access method of choice for urban or rural areas, developed or developing countries if they can be deployed as cheaply as their proponent's claim.

While the growth of the Internet has been impressive, the NII is a much more comprehensive, ambitious initiative that necessitates resolving significant issues and meeting critical objectives for Electronic Data Banks as well as other applications.

Finally, the network world is now international. Any national efforts, therefore, must consider the international context and implications. Regardless of the results, the future of electronic communication in the spheres of education, business, industry and government will hardly be same as that in the past.

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